DOCUMENT RESUME

ED 340 754 TM 018 010

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TITLE Assessing College Education: What Can Be Learned from Practices in Industry?
SPONS AGENCY National Center for Education Statistics (ED), Washington, DC.
PUB DATE Nov 91
NOTE 40p.; Commissioned paper prepared for a workshop on Assessing Higher Order Thinking & Communication Skills in College Graduates (Washington, DC, November 17-19, 1991), in support of National Education Goal V, Objective 5. For other workshop papers, see TM 018 009-024.
PUB TYPE Reports - Evaluative/Feasibility (142) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS College Graduates; *Educational Assessment; Educational Improvement; *Evaluation Methods; Evaluation Utilization; Higher Education; *Industry; Job Analysis; National Programs; Occupational Tests; Outcomes of Education; *Personnel Evaluation; *Student Evaluation; Testing Programs; Work Sample Tests
IDENTIFIERS *National Education Goals 1990; *Performance Based Evaluation

ABSTRACT

What can be learned from the experience of analyzing jobs and testing employees in industry that can help advance the goal of assessing and improving college performance is summarized. It is apparent that grades, the traditional way of measuring college performance, do not explain much about one's performance in employment. There are two areas where industry assessments are most applicable to the national goal of improving and assessing the performance of college students. The first area concerns efforts to identify knowledge, skills, and abilities that are required for jobs (job analysis). The second area concerns employee assessments, especially in selection tests. Several job analysis methods and selection test types are described, including: (1) ability tests; (2) biodata; and (3) work samples. A first step in making college experiences more accessible and useful for employers would be to assemble information about student performance in more innovative ways. The next step would be to encourage education to be conducted in ways that develop job-related skills. A 54-item list of references is included. The appendixes provide graphs, a chart, and a discussion of job and job functions analyses. Reviews by E. M. Greenberg, M. A. Miller, and M. L. Tenopyr of this paper are provided. (SLD)

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Peter Cappelli[1]

Introduction

It is perhaps no surprise that the general concern about educational performance in the U.S. has spread from primary and secondary school issues to include the performance of students in college. Roughly one-half of U.S. students go on to some form of higher education, and a large proportion of them are subsidized by the government. The society relies on higher education to provide many of the skills necessary for an effective labor force and citizenry. All of these concerns make the performance of students in higher education an important issue for public policy.

The National Education Goals Panel has set as one its objectives the development of a method of tracking the performance of college graduates. The purpose of this paper is to summarize what can be learned from the experience of analyzing jobs and testing employees in industry that could help advance the goal of assessing and improving college performance. Industry experience in this area is typically concerned with improving job performance, and that is certainly only one of many important goals of education. But job performance and overall economic performance are important enough issues for individuals and for public policy to merit paying attention to any lessons that might be available.

Relationship between Education and Job Performance

The place to begin examining the lessons that industry practices might have for education is the relationship between education and the performance of employees. Higher education is obviously a prerequisite for many occupations in medicine and engineering, for example, where at least some of the information needed appears to be most easily taught in college. But the concern here is about the relationship between performance in college and in later employment: What effects does education, especially at the college level, have on performance, and what aspects of education are most important in producing effective employees? Scholars in labor economics and industrial psychology have examined this question. The fact that they tend not to read each other's work illustrates a communication problem that also applies to students in school (see below).

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[1] Co-director, National Center on the Educational Quality of the Workforce. This paper was prepared for a National Center for Education Statistics (NCES) workshop in support of efforts to assess and improve the performance of students in college education, Goal 5 of the National Education Goals Panel.

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Bishop (1989) surveys research on performance in high school and finds that it explains almost nothing about work experience: Although getting the credential of a high school diploma is very important, better performance in the form of higher grades does not improve the probability of getting a job, or wages once one has a job. Most of this research is based on data from the National Longitudinal Sample (NLS) which tracked the experiences of a cohort of 1972 high school graduates over time. Research on the relationship between performance in college and on the job using the NLS have been complicated by difficulties in coding college transcript data (see Edelman??). While the results are not always consistent, college grades do not appear to be good predictors of getting jobs or wages. Wise (1975) finds, however, that grades and school quality are significantly related to wage increases within the same employer using employment records within a large company.

Other data show clearly, however, that there is a big payoff for completing a college degree, as opposed to simply taking college courses. The decline in the economic return for earning a college degree (measured in terms of wages) during the 1970s sharply reversed in the 1980s. While the return to earning a high school degree also increased, the gains from a college degree are significantly greater.[2]

The other set of research, mainly by industrial psychologists, is much more extensive. It typically uses employer data sets and direct measures of job performance (as opposed to indirect measures such as wages) as the measure of worker success. These studies have been popular for at least 50 years, and it has been well-established for decades now that college grades are not good predictors of job performance (see McClelland 1973, for example). Most researchers do not bother trying to publish studies showing the absence of significant relationships, and journals typically are not interested in publishing them.[3] While there are studies that find relationships between grades and some measures of job performance in individual firms, it is remarkable -- given the bias toward not reporting insignificant results -- how many published studies there are that report no significant relationships between grades and job performance. Bretz (1989) performs a meta analysis of previous grade point average research and finds no overall relationship with adult achievement in the workplace among a large sample of studies. Dye and Reck (1989) use a slightly different sample, a series of corrections for possible sampling error and unreliability of the validity construct in the original studies, and report a larger overall validity coefficient, but it is still quite small (.18). (Validity coefficients are correlations, and their square is the coefficient of determination, the popular R2 measure. Dye and Reck's .18 correlation, for example, means that grades explain .032 percent of the

[2] These conclusions are drawn from a conference "Returns to Education" held by the National Center on the Educational Quality of the Workforce (EQW) in August 1991. A paper summarizing the conference results is being prepared by Paul Taubman and will be available from the EQW Center shortly.

[3] The rationale for these actions is that it is difficult to draw any conclusions about the absence of significant effects because there are a range of problems that can mask significant results.

variance in job performance measures.)[4]

Even the proponents of using grades as predictors only claim that they have some relevance -- not that they are powerful predictors in the absolute sense. It is easy to find studies of grade point averages in almost every context that find no relationships with performance; in business, using overall measures of job success (e.g., Ferris 1982), in engineering (Muchinsky and Hoyt 1973), performance in graduate programs (Harrell and Harrell 1984, cited in Howard 1986). Even the quality of the college, measured by its selectivity in admissions, has been shown to add little to predictions of job performance (e.g., Ferris 1982, Howard 1986; Rosenbaum (1984). Perhaps the most successful attempts to find relationships was by Howard (1986) at AT&T using assessment center data on employee abilities as an indirect measure of job performance.[5] She finds that undergraduate grades have statistically significant relationships with only about one-quarter of the measures of job performance and potential; the very best of those relationships out of the 50 or so reported are with potential for promotion and are no higher than 0.40. Reviewers of all categories of selection procedures such as Reilly and Chao (1982) assert that grades are well down the list of options in terms of their predictive power.

Bishop suggests that the poor relationship between grades and job performance at the high school level occurs because employers do not get information about school performance (they do not receive transcripts, e.g.) and would not be sure how to interpret such information if they did receive it. This does not appear to be the case for college grades, however. Anecdotal evidence suggests strongly that employers do get college transcripts and do understand them, especially within professional fields like engineering and business.

It is interesting to note that the studies finding significant relationships between college grades and job performance are more likely to find them for subcategories of grades that offer a closer link between school and work: Dye and Beck's (1989) survey finds that grades in one's major are better predictors; Bretz's (1989) survey finds that grades explain performance better in business and education where students are more likely to have received training in programs specific to those fields; Howard (1986) also finds that graduate grades are better predictors than undergraduate grades and that grades in a specific business program (MBA) are even better than

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[4] Proponents of using grades point out that even small validity coefficients may be economically useful; assuming that the standard deviation of performance in a particular job is equivalent to $10,000 per year (reasonable for management jobs), a validity coefficient of .10 for grades implies an improvement over chance of $1,000 per year in performance when using grades as a selection device, a substantial gain when measured as present discounted value. Statistical corrections due to the fact that performance criteria are often uncertain and that the range of performance is restricted by the selection process (i.e., those hired may be more similar than the overall pool of applicants) can change the validity coefficients substantially, often raising them. The American Psychological Association (1985) suggests that these corrections by reported along with the regular validity coefficients. On the other hand, these validity studies of grades typically do not report what the marginal gain is from using grades as a predictor in addition to other predictors to determine whether even the small predictive power of grades is in fact due to some other, confounding factor. It is possible, for example, that effort is what really matters for job performance, and grades are simply a proxy – a poor proxy – for effort.

[5] Note, however, that the assessment center data are not in fact real job performance data but are generated by situations – tests – used to proxy real performance.

masters degrees taken as a group. Weinstein and Srinivason (1974) also find relationships between grades in MBA programs and later salaries.

Certainly one hypothesis that could be drawn from the above literature is that college performance is irrelevant to performance in the workplace. An alternative hypothesis also consistent with the overall poor predictive power of grades is that there is something relevant and important about college performance but that grades simply do not proxy well. The fact that predictive power improves substantially as the links between education and jobs get closer -- in graduate and professional programs, e.g., where the preparation is for a specific job -- indicates that even grades may be revealing in the right circumstances. And there are other aspects of college education not usually considered by policymakers that may also be relevant to worklife. Howard (1986) finds, for example, that extra-curricular experiences are much better predictors of work performance than are grades, an issue that is explored below in the context of other selection devices that do predict well. It is nevertheless important not to lose sight of the basic fact that grades, the traditional method of assessing classroom performance in college, do not explain very much about one's performance in employment. The factors they are measuring may not be particularly useful for future jobs.

What Can We Learn from Industry Practice?

There are two areas where industry assessments are most applicable to the National Goal of improving and assessing the performance of students in college. The first is with efforts to identify the knowledge, skills, and abilities (KSA's) that are required for jobs, an effort typically referred to as job analysis. The results of job analyses are helpful in that they suggest what employees need to bring to a job in order to be successful. They also suggest the areas where colleges should be preparing students and, in turn, some of the learning that might be tracked in an evaluation scheme.

The second relevant area of industry experience is with employee assessments, especially efforts to identify and establish the characteristics that employees bring to a job that are predictive of future success. These efforts are known as selection tests, and they are typically used to evaluate job candidates before employment or promotion.

The assessment of jobs and people in industry is perhaps the central function of personnel systems. It is a multi-billion dollar industry that supports scores of consulting firms with long and deep roots in the behavioral sciences. The field of industrial/organizational psychology (Division 14 of the American Psychological Association) is devoted in large part to the study and design of workplace tests, and the analysis of these assessments makes up a substantial component of leading journals in psychology such as the *Journal of Applied Psychology* and *Personnel Psychology*.

Research on job analysis and selection tests is likely to strike an outsider as the most extreme of normal science research, where debates turn on narrow differentiations of standard models. Virtually all of this research follows what has become known as the criterion-related

validation model: job analyses begin with efforts to develop and measure criterion for jobs, followed by efforts to develop selection tests to identify individuals who fit the needs established by the job analysis, and finally efforts to assess the validity of the selection tests -- do they in fact predict good performance? And virtually every aspect of this model has been analyzed repeatedly and in depth, but there are still many points of disagreement in the field. In brief, the conflicts typically center on differences in what is meant by saying that particular approaches are useful: Does useful mean compared to other procedures or compared to chance, for example? Every method has strong advocates -- including those who developed the assessment -- and critics. It is possible, however, to identify themes that cut across these methods.

Job Analysis

The phrase job analysis usually refers to systematic efforts to collect information about the work requirements associated with particular jobs. This information can be used for many purposes -- job descriptions for recruiting, compensation decisions, etc. Ghorpade and Atchinson (1980) discuss the rise and development of job analysis methods and conclude that while individual firms have been pursuing job analyses throughout much of this century, it received its biggest boost from court cases testing the constitutionality of selection procedures (see below). These cases effectively established the standard that selection should be based on actual job requirements, and this forced employers to introduce job analyses to determine that content.

Job analyses are really just a framework for describing jobs, and in general the same frameworks are used to assess the jobs filled by high school and college graduates. The various methods of job analyses can be divided into two broad categories. One focuses its descriptions on the job and on the tasks performed while the other is written from the perspective of the worker and describes what is needed from workers in order to perform a given job. The latter is clearly the more useful for the purposes at hand as it describes what jobs demand from workers. All of the job analysis methods described below are therefore taken from this worker-oriented category.

- ***Hay Associates Profile System:*** The Hay Group is a large compensation consulting firm that performs job analyses on jobs covering some 2 million workers in the U.S. Its job analysis focuses on three areas:

  "Know-how" concerns the techniques and procedures required by jobs. Examples of know-how would be professional skills, such as accounting or engineering, and general management skills such as designing plans. More specialized and technical skills and greater breadth required across skills is associated with more difficult jobs.

  "Problem Solving" refers to the thinking demands made by jobs. Routine, repetitive tasks fall at the lower end of this scale while those defined only abstractly, requiring adaptive abilities, fall at the upper end.

"Accountability" refers to the freedom jobs give employees to act. Jobs that offer employees little guidance and that also are associated with large impacts on the organization score high on this scale.

• ***The Position Analysis Questionnaire (PAQ)*** has been the most thoroughly researched and academically prominent of the job analysis methods (see McCormick and Jeanneret, 1988).[6] The theme of the PAQ is to identify the basic behaviors and aptitudes required of jobs. There are 187 items in the questionnaire which can be divided into six general categories: Information (where and how one gets information needed for the job), mental processes (reasoning, decision making, etc.), work output (physical activities, tools, etc.), relationships with others (measures of complexity), job context (social and physical context of work), and a catch-all "other" category. While the PAQ's focus on work behaviors, as opposed to tasks, has sometimes been criticized in the context of differentiating jobs, it is an advantage here in helping to identify what workers need to know.

The ability of the PAQ to identify basic work KSA's has been examined with a series of tests of the relationship between PAQ job scores and performance of job incumbents on the General Aptitude Test Battery (GATB), perhaps the most widely used test of employment aptitudes. The idea is that people gravitate toward jobs that use their skills, so these tests correlated GATB scores of incumbents with PAQ scores for their jobs. McCormick and Jeanneret (1988 p.831) summarize the results which are strong.[7] Also, private firm studies using commercial tests of intelligence, verbal aptitude, numerical, spacial, and clerical aptitude show reasonably good correlations with the PAQ, around .70. What these tests show is that PAQ measures of job requirements track the characteristics that workers in those jobs actually have. This is not the same as establishing validity -- identifying "true" requirements of jobs -- but these results are consistent with a valid measure under the assumption that workers sort themselves out by job according to KSA's.

• ***The Management Position Description Questionnaire*** was developed by Control Data Business Advisors for use with their own managerial employees but has become popular in many white collar organizations, in part because its focus on managerial jobs made it appear more applicable to them (see Page, 1988). The basic categories of this method of job analysis are presented in Appendix A, but the KSA's can be categorized as follows: leadership skills (motivation, coaching), administrative skills (planning, allocating), interpersonal skills (conflict management, group process skills), communications, decision making (information management, analytic ability), and professional knowledge (company-specific practices, technical skills such as accounting).

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[6] There is also a Professional and Managerial Position Questionnaire (PMPQ) which is very similar.

[7] The assumption is that current incumbents in jobs have exactly the KSA's necessary to do their jobs -- no overqualified or underqualified workers. At the very least, the match between KSA's and requirements cannot vary across jobs.

• ***The Threshold Traits Analysis System*** is a different approach that focuses explicitly on individual job holders, rather than on the jobs themselves, and examines the traits that they possess (Lopez 1988). Those traits can be broken down into ability factors, which are subdivided into aptitudes for acquiring knowledge or skill and proficiencies for skills already possessed; and attitudinal factors, which affect the willingness to perform at given levels. The specific traits are described in Appendix B and are categorized as follows: Physical traits such as strength, mental traits such as problem-solving and memory, learned knowledge and skills such as communication, motivation and adaptability, and social traits such as influence and cooperation.

• ***Ability Requirement Scales.*** These scales attempt to identify generic abilities and are based on 50 item categories identified in Appendix C. Perhaps more than the other job analysis systems described here, the Ability Requirements Scales focus on physical and perceptual factors. Among the nonphysical categories, communication skills, reasoning, and problem solving feature heavily (see Fleishman and Mumford, 1988).

• ***The Functional Job Analysis*** was developed out of the need to determine worker characteristics required for the jobs described in the *Dictionary of Occupational Titles*. This method is designed to be straightforward, and there are far fewer decisions for job analysts to make than in most methods. Appendix D describes the scales of the Functional Job Analysis which fall into seven categories: Data functions (complexity in the use of information), people functions (level of interpersonal skills demanded), functions using things (physical requirements, typically with machines), worker instructions (level of responsibility), reasoning development (from common sense to abstract undertakings), mathematical development (math skills), and writing functions (see Fine 1988).

• *SCANS* (Secretary's Commission on Achieving Necessary Skills) is a public policy study of the KSA's that jobs in the economy as a whole currently demand. The Commission's charge was to identify the requirements for entry-level jobs. Once those generic job requirements were identified, they could then be used to help shape what is taught in schools. The *SCANS* report really amounts to a public policy-based job analysis.

The Commission identified five sets of general competencies required by entry level jobs: those associated with resources (organizing, planning, allocating), interpersonal skills, using and acquiring information, understanding systems, and working with technology. Underlying those competencies were three sets of what the Commission called "foundations." They are; basic skills (reading, writing, math, listening, and speaking); thinking skills (creative thinking, decision making, problem solving, visualizing symbols, reasoning, and knowing how to learn);

and personal qualities (responsibility, self-esteem, sociability, self-management, and integrity).[5]

There are dozens of other prominent job analyses, but the above list gives one a good sense of what the field looks like. While there are important differences in the various job analyses outlined above, as noted earlier, the differences seem to be variations on a very common theme. There have been attempts to assess systematically the differences in job analysis systems (see Levine, Ash, and Bennett 1980, for example), but most of these efforts concern issues such as ease of use. It is very difficult to assess the relative validity of different job analyses because there are no measures of the "true" requirements of jobs that are superior to job analyses themselves.

The categories of KSA's required by jobs does not, of course, indicate the level of performance required in those categories. It is difficult to calculate how good writing skills need to be, for example, in the average job that college graduates would be expected to fill. Not only does each job have a different mix of KSA's and a different level of acceptable performance, but each of the job analysis systems outlined above are proprietary and do not routinely publish normative data. (The organizations behind these different systems could produce representative requirements for given jobs if the government was interested in pursuing them.) The other problem is that jobs may very well be changing, so that the level and mix of KSA's currently required may be different by the time current college students enter employment. This issue is taken up below.

Several requirements cut across virtually every system of job analysis. They include the following sets of KSA's:

- Interpersonal skills
- Communications, both oral and written
- Critical thinking broadly defined (problem solving, reasoning, etc.)
- Motivation and other personal attitudinal characteristics
- Working with data and information
- Math skills

One conclusion that might immediately strike an outsider to this field is that job-specific knowledge and skills do not feature prominently in most job analysis schemes. The classroom knowledge of accounting methods, for example, is only one of many factors required for accounting jobs. And most jobs require far less classroom knowledge than accounting. There are many positions for which there is no equivalent college classroom instruction.

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[5] The public policy action with the most widespread impact in this area may be the efforts by the U.S. Department of Labor to identify the requirements of jobs that come through its Employment Services. The criterion used to determine what is demanded from workers includes the General Educational Development (GED) levels in reasoning, math, and language;, specific vocational preparations; aptitudes and temperaments; and physical demands. See Droege (1988).

On the other hand, most of the KSA's in the above list are taught in college, albeit some indirectly. Math skills are developed in math classes and in courses like the sciences which use applied math; critical thinking is taught explicitly in logic courses and should be a part of a broad array of courses from history to the social and behavioral sciences. Working with data is explicit in statistics courses and in all branches of the sciences which use applied statistics. Communications should be a part of every course that requires discussion and writing. Interpersonal skills are not typically an explicit part of college course work, although behavioral science courses on group dynamics do teach these skills. Motivation and personal characteristics such as integrity are no doubt the least likely to be taught in a classroom context, although military and religious schools make explicit attempts to develop these characteristics through socialization. Extracurricular activities such as athletics may develop them as well.

Suggestions as to how these sets of knowledge, skills, and abilities required in employment could be developed more thoroughly in college instruction do not need to be revolutionary. Courses in any subject where students are required to write papers, discuss material orally, and work in groups go a long way toward developing many of the above KSA's. And where such courses challenge students to analyze problems and think critically about them, we are more than half way toward completing the list. Courses that make use of math concepts and data increasingly cover a large proportion of college curricula -- math and statistics, all the sciences (natural, behavioral, and social), increasingly history and anthropology. These courses should challenge students to apply math and data analysis to problems, giving them practice in applications.

With this description, it becomes easy to see that grades may not be good predictors of job performance, even for subjects where the course material may be relevant to jobs, because the courses do not teach skills relevant to jobs and because grades are not based on those skills even where they are taught. Consider a course in human behavior that is taught in a large lecture format where students neither talk with the instructor nor with each other, and the requirements stress memorizing the results of prior research. Few job-related skills are developed in the process of presenting the course material. And multiple choice tests, which are typically used as the basis for grades, could not reveal them in any case. Now consider the same course taught in a small group discussion format where students do at least some of their work in teams; where the material requires students to apply theories and statistical methods to real life problems; where grades are based on written efforts to evaluate critically course material and on class participation. In the latter, the education process develops many useful skills, and the grading procedure can evaluate them.

Finally, it is important to remember that job analyses capture what is currently required by jobs and not what will be required in the future. There are many arguments suggesting that jobs will be changing in the future. These arguments fall into two groups. The first are represented by studies such as *Workforce 2000* which argue that the distribution of jobs in the economy is shifting away from low-skill positions such as manual work and toward higher skill jobs like engineering. The consensus about these studies suggests that while there is likely to be a shift in this direction, the rate of change will be no greater than in past generations.

The second set of arguments looks at changes in current jobs; how management jobs may

be different in the future, for example. Cappelli (1991) finds an increase in the KSA's required for production jobs but no clear pattern for clerical jobs. There is a great deal of argument about changes in college-level jobs, especially managerial work, although there is not much hard data to test these arguments. Certainly there is a consensus that managerial jobs have become less secure and that the ranks of managerial jobs have been thinned, leaving more work for those who remain (Cappelli, in press). But how exactly jobs have and will continue to change in terms of the KSA's required is more a matter of speculation.

Porter and McKibbin (1988) conducted a study for the American Assembly of Collegiate Schools of Business that considered how businesses were changing and the implications for jobs and education oriented toward management jobs. Their conclusions from extensive interviews suggest that education needs to be more applied -- help students see the links to practice -- and that interpersonal and leadership skills should be emphasized oriented toward managing people. The SEI Center at the Wharton School conducted a similar study as the basis for designing a new business school curriculum. The recommendations included more extensive training in interpersonal skills, greater integration across disciplines, and more breadth in education (Wind and West, in press).

We also conducted interviews with human resource consultants in firms that specialize in job analyses to get their thoughts on the future requirements of jobs.[9] There is a clear consensus that flatter organizations with less hierarchy are forcing employees to be more autonomous. The reduction in structure and control associated with it implies greater reliance on leadership skills as the alternative for managing employees. Communication skills are also becoming more important as employees have more informal reporting arrangements with more people and as matrix organizational structures and team methods of work organization force employees to work more with each other. Interpersonal skills in general become more important as working in teams becomes more prevalent. The ability to be flexible and adapt to new circumstances is another general theme that is driven by the continuing turbulence in modern corporations. These themes suggest that future jobs will demand even greater emphasis on the behavioral skills outlined above.

Selection Tests

As noted earlier, selection tests designed to predict performance follow logically from job analyses that identify the requirements of job performance. Selection tests can provide important information first as a check on job analyses about what really is important for good job performance. If the factors that predict (and presumably "cause") good performance can be identified, then perhaps they can be developed in college education. Second, the experience with

[9] Our thanks to Marsha Cameron at the Wyatt Company, Joy Hazucha at Personnel Decisions, Inc., Charles Lee at TPF&C (Towers Perrin), Andy Rosen at Hay Associates, and Eugene R. Smoley, Jr. at Cresap (Towers Perrin) for their thoughts on the changes in managerial jobs.

selection tests may offer some general recommendations for developing tests to assess college performance, especially if part of the goal is to provide information about students to employers.

Informal selection tests no doubt date to the beginning of employment -- hiring the biggest workers for manual jobs, e.g. -- but the systematic use of tests is often traced to the selection of street car conductors in Paris in 1908. WWI saw the rapid development of selection tests in the U.S. as the military sought some mechanisms for sorting the thousands of inductees on a rapid basis. Most of the military tests were efforts to assess basic abilities, and their use spread to industry after the war ended. Testing got another boost in WWII where a much more extensive set of tasks and job functions was matched with an equally extensive set of tests. Many of these tests -- especially for blue-collar work -- were translated directly to industry after the War.(DuBois 1970; Kochan and Cappelli 1984; Jacoby 1986.).

The main problem in assessing the performance of assessment tests is the poor quality and design of the available data. Because selection tests take place within firms, data on performance are only rarely made public, typically only if a researcher was involved in the study. When data are released, they are often contaminated. For example, if the results of tests affect employment decisions, then it is difficult to say whether the tests predicted or caused job performance. At least part of the disagreements about the validity of different selection procedures in this field can be attributed to the fact that researchers are often looking at different samples of assessment exercises. Despite the apparent partisanship, it is not difficult to reach general conclusions about the relative usefulness of different categories of selection procedures.

Whether one believes that selection tests do a good job depends in part on what one sees as their mission. Job performance in itself is a difficult concept to define, let alone measure, and the stochastic aspects of performance -- including factors that are beyond the control of individuals -- are very important. Given all this, selection tests have a very difficult mission. For employers, any improvement over chance counts as a big success, especially where the costs of the tests are minimal. On the other hand, even the best of these procedures explain no more than a third or so of the variance in performance. A validity coefficient of .50, for example, which would be associated only with the very best selection procedures (ones that effectively compare past performance in a job to future performance in a similar job), explain only .25 of the variance in performance.[10] And that looks like a much smaller figure when one considers using the procedure as the basis for public policy -- billions of dollars and the efforts of tens of thousands of educators and millions of students.

Given the information about what job analyses examine, it should not be a surprise to find that selection procedures do not explicitly test college classroom experiences (with the exception of jobs with occupation-specific skills such as accounting). Some selection procedures, such as personality tests and projective techniques (estimating underlying personality structures), focus on issues that are largely irrelevant to college classroom instruction. The selection procedures that make the most explicit use of material associated with college education are described below:

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[10] The square of the validity coefficient produces the coefficient of determination, the popular R2 statistic.

Ability Tests

Ability tests are designed to assess how much one has learned about a particular subject or area. They can be subdivided into achievement tests which focus on organized learning, typically classroom instruction of paradigmatic material, and aptitude tests which focus more on informal experiences and information. Aptitude is a prediction about future learning, and the argument is that such learning is easier when built upon a base of even informal information. Aptitude should not be confused with general intelligence or innate abilities which are measured in different ways (see below).

Perhaps the most popular ability tests measure mental aptitude, such as the early Stanford Binet, the Wonderlic Personnel Test or the popular Wechsler Adult Intelligence Scale. Other characteristics typically included under the heading of mental ability are immediate memory, arithmetic, and substitutions (applying algorithms). These tests have often been based on academic classroom material and are highly correlated with academic achievement; Gottfredson (1986) in Ash, et al. finds a correlation of .60 between general intelligence scores and educational achievement. As a result, these tests have been associated especially with determining the aptitude of candidates for formal training and further education.

Ability tests suffered serious setbacks when the Supreme Court found instances where they contributed to discrimination. Cases like *Griggs v. Duke Power* found that many ability tests were assessing characteristics that could not be shown to be directly job related, and their disparate impact on societal groups was therefore unconstitutional. In other words, they had no construct validity. In addition to whether these tests can assess abilities accurately (whether they are reliable), whether they have done a good job of predicting job performance is a very important point for the National Goals Panel: Reliable ability tests that do not predict workplace performance indicate that those abilities being measured are not in fact important to workplace performance.

Perhaps the best known and widely used ability test is the General Aptitude Test Battery (GATB) which has been in use for more than 40 years in a variety of public and private settings. Developed by the U.S. Employment Service as a screening device, GATB measures nine basic aptitudes: intelligence (general learning ability), verbal aptitude, numerical aptitude (arithmetic), spatial aptitude, form perception (perceive physical details), clerical perception (perception of verbal or tabular details), motor coordination, finger dexterity, and manual dexterity (hand movements).

The National Research Council (1989) conducted an extensive investigation of GATB at the time that the Employment Service was considering using it as the selection device for job placement decisions. GATB compared favorably to similar selection tests, such as the Armed Services Vocational Aptitude Battery (ASVAB), in terms of reliability and validity, although the Council describes the overall validity of GATB as "modest" (.35 for studies conducted before 1972; .25 for those after) and did not recommend that it be used as the sole criterion for selection decisions. Of the various items, the grouping of intelligence, verbal, and numerical aptitude (cognitive composite) was no better predictor of job performance than the other

composites and did not necessarily do better at predicting performance for those jobs most clearly associated with college education.[11]

Ghiselli (1974) surveys virtually all of the known validity studies of aptitude tests and classifies their average validities according to occupation. The results for managerial positions, those most closely associated with college educations, are reproduced in Appendix E. Intellectual abilities are useful, but personality traits appear to be the best predictor of both training success and proficiency. It is also interesting to note that pencil tapping ability, a test of motor skills, is not a bad predictor of future success (almost as good as intellectual abilities), although it is indeed hard to understand why this ability should be related to managerial job performance. This illustrates the difficulty in specifying causal connections between many of these predictors and performance, and it is a concern about ability tests in general.

Sparks (1983) summarizes the validity of a long-running selection program at Standard Oil of New Jersey known as the Early Identification of Management Potential. Beginning in 1955, the company administered an impressive number and variety of selection procedures to 600 employees. The items most associated with academic training, reasoning ability, had validities around .20, much lower than other predictors described below.

Various statistical corrections noted above (see footnote 4) can produce substantially higher estimates of validity; the corrections typically require judgment decisions -- about the true nature of the applicant pools, e.g. -- so that the "true" corrections are often in dispute. The corrections are typically no higher than .50 -- explaining 25 percent of the variance in performance. On the other hand, Reilly and Chao (1982) found that alternatives to ability tests -- interviews, self-assessments, reference checks, expert judgments, projective (personality) techniques, and academic performance -- were all substantially worse predictors.

Bio-Data

Information about a job candidate's background, including academic performance, is often referred to as "bio-data." Interest in this area began with early observations of relationships between information on employment applications and subsequent performance in industry and in the military. The theoretical arguments in support of bio-data are rooted in notions of consistency, that past performance -- other things equal -- predicts future performance. Sometimes these results are straightforward, as when success as in an engineering internship program predicts success as an engineer. But sometimes they are less obvious. One of the best-known anecdotes in this field is that the question "Did you ever build a model airplane that flew?" predicted success in flight training almost as well as the entire battery of aptitude tests administered in the U.S. Air Force during WWII.

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[11] Bishop (1989) used data from GATB validity studies to conduct one of the few attempts to assess the impact of aptitude tests on performance independent of other prediction devices and found that intelligence in particular remained significant.

Overall, bio-data is thought by many to be the best predictor of job performance available (see Owens 1976; Schneider 1976). Asher (1972) presented summary data suggesting that by some criteria, bio-data was almost twice as successful at predicting job performance as the next best method examined (intelligence aptitude). Sparks' (1983) data indicates that bio-data were far and away the best predictors of job proficiency. This is not to say that bio-data is an unqualified success, however. Korman (1966) found that it had real problems predicting managerial performance in his data and may be inferior to other methods for those jobs. But there is no doubt that prior life experiences are both empirically and conceptually strong predictors of job performance.

The problem with bio-data is in identifying which life experiences would be useful in predicting success in different types of jobs; in particular, which aspect of college performance other than grades (which do not predict well) might be relevant for job performance? College represents an important, fundamental period of development for most adults, and it would be remarkable if life experiences during that period did not explain something about later job performance. Howard (1986) finds, for example, that one's major subject in college was the best predictor of job performance at AT&T; participation in more extracurricular activities and more leadership positions in those activities was the next best predictor.

Work Samples:

Work samples are the selection device closest to achievement tests. The idea behind work samples is very straightforward; to assess whether someone will perform well as a typist, give them something to type. There is little doubt that work samples have the strongest conceptual validity because of the clear point-to-point consistency they bring with them. Asher and Sciarrino (1974) find that work samples are a close second to bio-data in terms of their validity. Schmitt, Gooding, Noe, and Kirsch (1984) found strong support for using work samples in their meta analysis. Assessment centers, a selection method using multiple simulations of real work problems ("in basket tests" are one popular component), can be thought of as using work sample methods specifically tailored for managerial jobs. (One important difference, however, is that assessment centers also attempt to secure information on issues other than work sample performance, such as aptitudes and personality.) Schmitt, Gooding, Noe, and Kirsch (1984) find that the average validity for assessment center scores was .43, a good performance.

The reason work sample tests are not used all the time is first, because it is difficult to create a work sample broad enough to assess the entire range of tasks that jobs with any complexity might entail. Assessment centers that duplicate this broad range of tasks are very expensive to use. Second, work samples assume that candidates need no further knowledge, skills, or abilities to perform the job. This would be true only for very simple jobs or for those in clearly defined craft/professional external labor markets. Work samples therefore might not suit entry-level jobs in internal labor markets, for example.

Conclusions

The brief survey above suggests some interesting conclusions about what might be learned from selection tests for college assessments. For example, the fact that grades do not predict performance well suggests that much of what is either assessed or taught in college is specific to each course (e.g., the facts of a history course) and does not contribute to long-term skills and knowledge. The fact that grades are better predictors for course work that has a closer link to specific occupations suggests that grades might be much more valid predictors of job performance if courses were redesigned to develop job relevant skills; courses that stressed group efforts, critical thinking in oral and written forms, and applications of math and data analysis.

The fact that bio-data and work samples are such good predictors of job performance makes one believe that information about college experiences, from the college transcript in particular, should be useful to employers. Given how fundamental college years are for most people, it would seem incredible if information about a student's experience in college could not be used as a good predictor of later performance; think of college as a 24-hour per day, multi-year assessment center. Many of the more micro learning experiences in college are the equivalent of work samples for future job performance. For example, research papers should be excellent tests of written communication skills and problem solving skills; laboratory experiments should reveal a great deal about the ability to analyze data; performance in applied math and statistics courses clearly reveal math and data skills, and architecture and design courses may also reveal a great deal about spatial relations, a key predictor of performance in many occupations. To get some sense of how rich the information about college experiences could be, consider what it would cost to obtain some of the same information from assessment centers.

The first step toward making college experiences more accessible and useful for employers might be for colleges to begin to assemble information about student performance in more innovative ways. For example, it might be useful to have an overall measure of performance on written material -- the average grade on all research papers and essays, for example. Such an indicator only requires compiling existing data in a different way. The University of Michigan, William and Mary, and other colleges already compile portfolios of student work over their entire program, producing material that could easily be used in bio-data analyses.

The next step would be to encourage the process of education in the classroom to be conducted in ways that develop job-related skills. These steps do not require fundamental changes in the content of courses as much as they do in pedagogy.

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INDIVIDUAL POSITION PROFILE
WORK DIMENSIONS

Name:	J C DOE	**Functional Area:**	HUMAN RESOURCES
Employee I.D.:		**Organization:**	BUS. ADVISORS
Position Title:	MANAGER	**% of Job Described:**	90%
Supervisory Level:	SUPERVISOR	**Date Completed:**	9/11/84

Average Level of Significance

WORK DIMENSIONS	Average Rating
Decision Making	2.4
Planning & Organizing	1.1
Administering	1.8
Controlling	1.1
Supervising	1.2
Consulting & Innovating	3.8
Coordinating	1.9
Representing	2.3
Monitoring Business Indicators	1.2

Job Evaluation Points

JOB EVALUATION FACTORS	Factor Weight	Factor Score
Decision Making	1.00	43.6
Problem Solving	0.50	49.8
Organizational Impact	0.75	45.6
Human Resources Responsibility	1.00	37.9
Know-How	0.75	54.3
Contacts	0.25	48.7

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Job Analysis 3

Fig. 8.4.4 The Individual Position Profile report. © 1984 Control Data Business Advisors, Inc. All rights reserved. Reprinted with permission.

MULTIDIMENSIONAL JOB PROFILE
PERFORMANCE AND COMPETENCY FACTORS

Job Title: STAFF MANAGER
Functional Area: ADMINISTRATION
Organization: CONTROL DATA

Number Surveyed for this Job: 10
Average Percent of Job Described: 94%
Range of Dates Completed: 2/ 1/85 TO 5/28/85

Average Level of Significance

PERFORMANCE FACTORS	Average Signif.
Managing Work	1.7
Business Planning	1.6
Problem Solving/Decision Making	2.0
Communication	2.0
Customer/Public Relations	0.6
Human Resource Development	2.4
Human Resource Management	2.2
Organizational Support/Interface	2.7
Job Knowledge	1.3

Not a Part · Minor · Moderate · Substantial · Crucial

Average Level of Proficiency

KNOWLEDGE, SKILLS & ABILITIES	Average Rating
Leadership	2.9
Coaching & Developing	2.9
Motivating	2.5
Delegating & Monitoring	2.9
Planning	3.3
Allocating Resources	2.8
Administrative Skills	2.8
Personal Organization/Time Mgmt.	3.1
Human Relations/Sensitivity	2.8
Coordination	3.2
Group Process Skills	2.8
Negotiation	2.6
Conflict Management	2.4
Influencing/Persuading	2.9
Customer/Public Relations	2.7
Oral Expression	3.1
Presentation Skills	2.7
Active Listening	3.3
Written Composition	2.9
Information Management	2.0
Analytic Ability	2.8
Judgement/Decision Making	2.9
Mathematical Skills	2.2
Innovation & Resourcefulness	3.0
Professional/Technical Knowledge	0.8
Organizational Practices	2.0
Sales/Marketing Knowledge	0.4
Economic & Business Trends	0.2
Legislative Trends	0.5
Company Products & Services	1.0
Computer Usage	0.9

Not Required · Basic · Fully Adequate · Skilled · Outstanding

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Job Analyzed

Fig. 8.4.5 The Multidimensional Job Profile report. © 1984 Control Data Business Advisors, Inc. All rights reserved. Reprinted with permission.

AREA	JOB FUNCTIONS	TRAIT	DESCRIPTION-CAN:
PHYSICAL	Physical Exertion	1 Strength	Lift, pull or push physical objects.
		2 Stamina	Expend physical energy for long periods.
	Bodily Activity	3 Agility	React quickly; has dexterity, coordination.
	Sensory Inputs	4 Vision	See details and color of objects.
		5 Hearing	Recognize sound, tone and pitch.
MENTAL	Vigilance and Attention	6 Perception	Observe and differentiate details.
		7 Concentration	Attend to details amid distractions.
		8 Memory	Retain and recall ideas.
	Information Processing	9 Comprehension	Understand spoken and written ideas.
		10 Problem-solving	Reason and analyze abstract information.
		11 Creativity	Produce new ideas and products.
LEARNED	Quantitative Computation	12 Numerical Computation	Solve arithmetic and numerical problems.
	Communications	13 Oral Expression	Speak clearly and effectively.
		14 Written Expression	Write clearly and effectively.
	Action Selection and Projection	15 Planning	Project a course of action.
		16 Decision-making	Choose a course of action.
	Application of Information and Skill	17 Craft Knowledge	Apply specialized information.
		18 Craft Skill	Perform a complex set of activities.
MOTIVATIONAL	Unprogrammed	19 Adaptability – Change	Adjust to interruptions and changes.
	Cycled	20 Adaptability – Repetition	Adjust to repetitive activities.
	Stressful Working	21 Adaptability – Pressure	Adjust to critical and demanding work.
	Secluded Conditions	22 Adaptability – Isolation	Work alone or with little personal contact.
	Unpleasant	23 Adaptability – Discomfort	Work in hot, cold, noisy work places.
	Dangerous	24 Adaptability – Hazards	Work in dangerous situations.
	Absence of Direct Supervision	25 Control – Dependability	Work with minimum of supervision.
	Presence of Difficulties	26 Control – Perseverance	Stick to a task until completed.
	Unstructured Conditions	27 Control – Initiative	Act on own, take charge when needed.
	Access to Valuables	28 Control – Integrity	Observe regular ethical and moral codes.
	Limited Mobility	29 Control – Aspirations	Limit desire for promotion.
SOCIAL	Interpersonal Contact	30 Personal Appearance	Meet appropriate standards of dress.
		31 Tolerance	Deal with people in tense situations.
		32 Influence	Get people to cooperate.
		33 Cooperation	Work as a member of the team.

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Fig. 8.5.1 TTAS area functions and traits.

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APPENDIX: FUNCTIONAL JOB ANALYSIS SCALES

Worker Function Scales

Data Function Scale

Data is information, ideas, facts, statistics, specifications of oulputs, knowledge of conditions; techniques, men operations.

Level 1: Comparing. Selects, sorts, or arranges data, people, or things, judging whether their readily observa functional, structural, or compositional characteristics are similar to or different from prescribed standards (e. checks oil level, tire pressure, worn cables; observes hand signal of worker indicating movement of load).

Level 2: Copying. Transcribes, enters, and/or posts data, following a schema or plan to assemble or ma things and using a variety of work aids. Transfers information mentally from plans, diagrams, instructions workpiece or work site (e.g., attends to stakes showing a grade line to be followed while operating equipmer

Level 3A: Computing. Performs arithmetic operations and makes reports and/or carries out a prescribed acti in relation to them. Interprets mathematical data on plans, specifications, diagrams, or blueprints (e.g., reads a follows specifications on stakes).

Level 3B: Compiling. Gathers, collates, or classifies information about data, people, or things; following schema or system but using discretion in application (e.g., considers wind, weather (rain or shine), shape, wei and type of load, heights and capacity of boom in making lift).

(consequences) and to consider alternatives (e.g., considers/evaluates instructions, site and climatic condition nature of load, capacity of equipment, other crafts engaged with in order to situate (spot) crane to best advantage

Level 5A: Innovating. Modifies, alters, and/or adapts existing designs, procedures, or methods to meet uniq specifications, unusual conditions, or specific standards of effectiveness within the overall framework of operati theories, principles, and/or organizational contexts (e.g., improvises using existing attachments, or modifi customary equipment to meet unusual conditions and fulfill specifications).

Level 5B: Coordinating. Decides times, place, and sequence of operations of a process, system, or organizatio and/or the need for revision of goals, policies (boundary conditions), or procedures on the basis of analysis of da and of performance review of pertinent objectives and requirements. Includes overseeing and/or executir decisions and/or reporting on events (e.g., selects/proposes equipment best suited to achieve an output, considerir resources [equipment, costs, manpower] available to get job done).

Level 6: Synthesizing. Takes off in new directions on the basis of personal intuitions, feelings, and ideas (wit or without regard for tradition, experience, and existing parameters) to conceive new approaches to or statemen of problems and the development of system, operational, or aesthetic *solutions* or *resolutions* of them typical outside of existing theoretical, stylistic, or organizational context.

People Function Scale

The people scale measures live interaction between people, communication, interpersonal actions.

Level 1: Taking Instructions/Helping. Attends to the work assignment, instructions, or orders of perviso No immediate response or verbal exchange is required unless clarification of instruction is needed.

Level 2: Exchanging Information. Talks to, converses with, and/or signals people to convey r obtai information, or to clarify and work out details of an assignment, within the framwork of well- tablishe procedures (e.g., requests clarification of a signal, verbal [in person or on radio], or hand signal).

Level 3A: Coaching. Befriends and encourages individuals on a personal, caring basis by approxima ng a pe or family-type relationship either in a one-to-one or small group situation; gives instruction, advice, an person assistance concerning activities of daily living, the use of various institutional services, and participation in grou (e.g., gives support or encouragement to apprentice or journeyman on unfamiliar piece of equipmen).

Level 3B: Persuading. Influences others in favor of a product, service, or point of view by talks or demonstr tions (e.g., demonstrates safety procedures required on a piece of equipment for compliance with new regulations

Level 4A: Consulting. Serves as a source of technical information and gives such information or provides idea to define, clarify, enlarge upon, or sharpen procedures, capabilities, or product specifications (e.g., informs proje managers of effective and appropriate use of equipment to achieve output within constraints [time, money, etc.]

Level 4B: Instructing. Teaches subject matter to others or trains others including animals, through explanatio demonstration, and test.

Level 5: Supervising. Determines and/or interprets work procedure for a group of workers; assigns specifi duties to them (delineating prescribed and discretionary content); maintains harmonious relations among them evaluates performance (both prescribed and discretionary) and promotes efficiency and other organization values; makes decisions on procedural and technical levels.

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Level 6: Negotiating. Bargains and discusses on a formal basis as a representative of one side of a transaction for advantages in resources, rights, privileges, and/or contractual obligations, *giving and taking* within the limits provided by authority or within the framework of the perceived requirements and integrity of a program.

Level 7: Mentoring. Works with individuals having problems affecting their life adjustment in order to advise, counsel, and/or guide them according to legal, scientific, clinical, spiritual, and/or other professional principles. Advises clients on implications of analyses or diagnoses made of problems, courses of action open to deal with them, and merits of one strategy over another.

Things Function Scale

Physical interaction with and response to tangibles - touched, felt, observed, and related to in space; images visualized spatially.

Level 1A: Handling. Works (cuts, shapes, assembles, etc.), digs, moves, or carries objects or materials where objects, materials, tools, etc., are one or few in number and are the primary involvement of the worker. Precision requirements are relatively gross. Includes the use of dollies, handtrucks, and the like. (Use this rating for situations involving casual use of tangibles.)

Level 1B: Feeding/Offbearing. Inserts, throws, dumps, or places materials into, or removes them from, machines or equipment that is automatic or tended/operated by other workers. Precision requirements are built in, largely out of control of worker.

Level 1C: Tending. Starts, stops, and monitors the functioning of machines and equipment set up by other workers where the precision of output depends on keeping one to several controls in adjustment, in response to automatic signals according to specifications. Includes all machine situations where there is no significant setup

Level 2A: Manipulating. Works (cuts, shapes, assembles, etc.), digs, moves, guides, or places objects or materials where objects, tools, controls, etc., are several in number. Precision requirements range from gross to fine. Includes waiting on tables and the use of ordinary portable power tools with interchangeable parts and ordinary tools around the home, such as kitchen and garden tools.

Level 2B: Operating/Controlling I. Starts, stops, controls, and adjusts a machine or equipment designed to fabricate and/or process data, people, or things. The worker may be involved in activating the machine, as in typing or turning wood, or the involvement may occur primarily at startup and stop as with a semiautomatic machine. Operating a machine involves readying and adjusting the machine and/or material as work progresses. Controlling equipment involves monitoring gauges, dials, etc., and turning valves and other devices to control such items as temperature, pressure, flow of liquids, speed of pumps, and reactions of materials. (This rating is to be used only for operations of one machine or one unit of equipment.)

Level 2C: Driving/Controlling. Starts, stops, and controls (steers, guides) the actions of machines/vehicles in two-dimensional spaces for which a course must be followed to move things or people. Actions regulating controls require continuous attention and readiness of response to traffic conditions.

Level 2D: Starting Up. Readies powered mobile equipment for operation, typically following standard procedures. Manipulates controls to start up engines, allows for warm-up and pressure build-up as necessary, checks mobility where movement is involved, and working parts (as in construction equipment), brakes, gauges indicating serviceability (fuel, pressure, temperature, battery output, etc.) and visually checks for leaks and other unusual conditions. Includes reverse shutdown procedures.

Level 3A: Precision Working. Works, moves, guides, or places objects or materials according to standard practical procedures where the number of objects, materials, tools, etc., embraces an entire craft and accuracy expected is within final finished tolerances established for the craft. (Use this rating where work primarily involves manual or power hand tools.)

Level 3B: Setting Up. Installs machines or equipment; inserts tools, alters jigs, fixtures, and attachments, and/or repairs machines or equipment to ready and/or restore them to their proper functioning according to job order or blueprint specifications. Involves primary responsibility for accuracy. May involve one or a number of machines for other workers or for worker's own operation.

Level 3C: Operating/Controlling II. Starts, stops, controls, and continuously modifies set-up of equipment designed to hoist and move materials in multidimensional space, reshape and/or pave the earth's surface. Manipulation of controls requires continuous attention to changing conditions, and readiness of response to activate the equipment in lateral, vertical, and/or angular operations.

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The Worker Instructions Scale defines *Responsibility* in terms of specifications (that which is prescribed) and judgment (that which is specifically left to discretion) assigned to the worker. This can range across several levels depending on the activity(ies).

Level 1. Inputs, outputs, tools, equipment, and procedures are all specified. Almost everything the worker needs to know is contained in his or her assignment. He or she is supposed to turn out a specified amount of work or a standard number of units per hour or day.

Level 2. Inputs, outputs, tools, and equipment are all specified, but the worker has some leeway in the procedures and methods he or she can use to get the job done. Almost all the information he or she needs is in his or her assignment. Production is measured on a daily or weekly basis.

Level 3. Inputs and outputs are specified, but the worker has considerable freedom as to procedures and timing, including the use of tools and/or equipment. He or she may have to refer to several standard sources for information (handbooks, catalogs, wall charts). Time to complete a particular product or service is specified, but this varies up to several hours.

Level 4. Output (product or service) is specified in the assignment, which may be in the form of a memorandum or of a schematic (sketch or blueprint). The worker must work out his or her own ways of getting the job done, including selection and use of tools and/or equipment, sequence of operations (tasks), and obtaining important information (handbooks, etc). Workers may either carry out work themselves or set up standards and procedures for others.

Level 5. Same as (4) above, but in addition the worker is expected to know and employ theory so that he or she understands the whys and wherefores of the various options that are available for dealing with a problem and can independently select from among them. He or she may have to do some reading in the professional and/or trade literature in order to gain this understanding.

Level 6. Various possible outputs are described that can meet stated technical or administrative needs. The worker must investigate the various possible outputs and evaluate them in regard to performance characteristics and input demands. This usually requires his or her creative use of theory well beyond referring to standard sources. There is no specification of inputs, methods, sequences, sources, or the like.

Reasoning Development Scale

The Reasoning Development Scale is concerned with knowledge and ability to deal with theory versus practice, abstract versus concrete, and many versus few variables.

Level 1

Have the common sense understanding to carry out simple one- or two-step instructions in the context of highly standardized situations.

Recognize unacceptable variations from the standard and take emergency action to reject inputs or stop operations.

Level 2

Have the commonsense understanding to carry out detailed but uninvolved instructions where the work involves a *few* concrete/specific variables in or from standard/typical situations.

Level 3

Have the commonsense understanding to carry out instructions where the work involves several concrete/specific variables in or from standard/typical situations.

Level 4

Have knowledge of a system of interrelated procedures, such as bookkeeping, internal combustion engines, electric wiring systems, nursing, farm management, ship sailing, or machining.

Apply principles to solve practical everyday problems and deal with a variety of concrete variables in situations where only limited standardization exists.

Interpret a variety of instructions furnished in written, oral, diagrammatic, or schedule form.

Level 5

Have knowledge of a field of study (engineering, literature, history, business administration) having immediate applicability to the affairs of the world.

Define problems, collect data, establish facts, and draw valid conclusions in controlled situations.

Interpret an extensive variety of technical material in books, manuals, texts, etc.

Deal with some abstract but mostly concrete variables.

Level 6

Have knowledge of a field of study of the highest abstractive order (e.g., mathematics, physics, chemistry, logic, philosophy, art criticism).

Deal with nonverbal symbols in formulas, equations, or graphs.

Understand the most difficult classes of concepts.

Deal with a large number of variables and determine a specific course of action (e.g., research, production) on the basis of need.

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Mathematical Development Scale

The Mathematical Development Scale is concerned with knowledge and ability to deal with mathematical problems and operations from counting and simple addition to higher mathematics.

Level 1
Counting to simple addition and subtraction; reading, copying, and/or recording of figures.

Level 2
Use arithmetic to add, subtract, multiply, and divide whole numbers. Reading scales and gauges as in powered equipment where readings and signals are indicative of conditions and actions to be taken.

Level 3
Make arithmetic calculations involving fractions, decimals, and percentages. Mentally acts upon dimensional specifications marked on material or stakes.

Level 4
Performs arithmetic, algebraic, and geometric procedures in standard practical applications.

Level 5
Have knowledge of advanced mathematical and statistical techniques such as differential and integral calculus, factor analysis, and probability determination.
Work with a wide variety of theoretical mathematical concepts.
Make original applications of mathematical procedures, as in empirical and differential equations.

Level 1
Cannot read or write but can follow simple oral, *pointing-out* instructions.
Sign name and understand ordinary, routine agreements when explained, such as those relevant to leasing a house; employment (hours, wages, etc.); procuring a driver's license.
Read lists, addresses, safety warnings.

Level 2
Read short sentences, simple concrete vocabulary; words that avoid complex Latin derivatives (exploded diagrams, comic books, action-type, i.e., western, mystery magazines).
Converse with service personnel (waiters, ushers, cashiers).
Copy written records precisely without error.
Keep taxi driver's trip record or service maintenance record.

Level 3
Comprehend orally expressed trade terminology (jargon) of a specific technical nature.
Read material on level of the *Reader's Digest* and straight news reporting in popular *mass* newspapers.
Comprehend ordinary newscasting (uninvolved sentences and vocabulary with focus on events rather than on their analysis).
Copy written material from one record to another, catching gross errors in grammar.
Fill in report forms, such as Medicare forms, employment applications, and card form for income tax.

Level 4
Write routine business correspondence reflecting standard procedures.
Interview job applicants to determine work best suited for their abilities and experience; contact employers to interest them in services of agency.
Read and comprehend technical manuals and written instructions as well as drawings.
Conduct opinion research surveys involving stratified samples of the population.

Level 5
Write instructions for assembly of prefabricated parts into units.
Write instructions and specifications concerning proper use of machinery.
Write copy for advertising. Report news for the newspapers, radio, or TV.
Prepare and deliver lectures for audiences that seek information about the arts, sciences, and humanities, in an informal way.

Level 6
Report, write, or edit articles for technical and scientific journals or journals of advanced literary criticism (e.g., *Journal of Educational Sociology, Science, Physical Review, Daedalus*).

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Table 8.7.1 Updated Definitions for the Ability Categories in Recent Forms of the Manual for the Abilit Requirement Scales (MARS)

1. *Oral Comprehension* This is the ability to understand spoken English words and sentences.
2. *Written Comprehension* This is the ability to understand written sentences and paragraphs.
3. *Oral Expression* This is the ability to use English words or sentences in speaking so others will understand
4. *Written Expression* This is the ability to use English words or sentences in writing so others will understand
5. *Fluency of Ideas* This is the ability to produce a number of ideas about a given topic.
6. *Originality* This is the ability to produce unusual or clever ideas about a given topic or situation. It is the ability to come up with creative solutions to problems or to develop new procedures to situations where standard operating procedures do not apply.
7. *Memorization* This is the ability to remember information, such as words, numbers, pictures, and procedures Pieces of information can be remembered by themselves or with other pieces of information.
8. *Problem Sensitivity* This is the ability to tell when something is wrong or is likely to go wrong. It includes being able to identify the whole problem as well as the elements of the problem.
9. *Mathematical Reasoning* This is the ability to understand and organize a problem and then to select a mathematical method or formula to solve the problem. It encompasses reasoning through mathematical problems in order to determine appropriate operations that can be performed to solve problems. It also includes the *understanding or structuring* of mathematical problems. The actual manipulation of numbers is *not* included in this ability.
10. *Number Facility* This ability involves the degree to which adding, subtracting, multiplying, and dividing can be done quickly and correctly. These can be steps in other operations, such as finding percents and taking square roots.
11. *Deductive Reasoning* This is the ability to apply general rules to specific problems to come up with logical answers. It involves deciding if an answer makes sense.
12. *Inductive Reasoning* This is the ability to combine separate pieces of information, or specific answers to problems, to form general rules or conclusions. This involves the ability to think of possible reasons why things go together.
13. *Information Ordering* This is the ability to correctly follow a rule or set of rules to arrange things or actions in a certain order The rule or set of rules to be used must already be given. The things or actions to be put in order can include numbers, letters, words, pictures, procedures, sentences, and mathematical or logical operations.
14. *Category Flexibility* This is the ability to produce many rules so that each rule tells how to group a set of things in a different way. Each different group must contain at least two things from the original set of things.
15. *Speed of Closure* This ability involves the degree to which different pieces of information can be combined and organized into one meaningful pattern quickly. It is not known beforehand what the pattern will be. The material may be visual or auditory.
16. *Flexibility of Closure* This is the ability to identify or detect a known pattern (such as a figure, word, object) that is hidden in other material. The task is to pick out the pattern you are looking for from the background material.
17. *Spatial Orientation* This is the ability to tell where you are in relation to the location of some object or to tell where the object is in relation to you.
18. *Visualization* This is the ability to imagine how something will look when it is moved around or when its parts are moved or rearranged. It requires the forming of mental images of what patterns or objects would look like *after certain changes*, such as unfolding or rotation. One has to predict what an object, set of objects, or pattern would look like after the changes were carried out.
19. *Perceptual Speed* This ability involves the degree to which one can compare letters, numbers, objects, pictures, or patterns, both quickly and accurately. The things to be compared may be presented at the same time or one after the other. This ability also includes comparing a presented object with a remembered object.
20. *Control Precision* This is the ability to move controls of a machine or vehicle. This involves the degree to which these controls can be quickly and repeatedly moved to exact positions.
21. *Multilimb Coordination* This is the ability to coordinate movements of two or more limbs (for example, two arms, two legs, or one leg and one arm) together, such as in moving equipment controls. Two or more limbs are in motion, while the individual is sitting, standing, or lying down.
22. *Response Orientation* This is the ability to choose between *two or more movements* quickly and accurately when *two or more different signals* (lights, sounds, pictures, etc.) are given. The ability is concerned with the *speed* with which the right response can be *started* with the hand, foot, etc.
23. *Rate Control* This is the ability to adjust an equipment control in response to *changes* in the speed and/or direction of a continuously moving object or scene. The ability involves timing these adjustments in anticipating these changes. This ability does *not* extend to situations in which both the speed and direction of the object are perfectly predictable.
24. *Reaction Time* This is the ability to give *one* fast response to *one* signal (sound, light, picture, etc.) when it [illegible] *started* with the hand, foot,

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an arm movement as well as while holding the arm and hand in one position. This abil y does *not* involve strength or speed.

26. *Manual Dexterity* This is the ability to make skillful, coordinated movements of one hand, a hand together with its arm or two hands to grasp, place, move, or assemble objects such as hand tools or blocks. This ability involves the degree to which these arm-hand movements can be carried out quickly. It does not involve moving machine or equipment controls such as levers.
27. *Finger Dexterity* This is the ability to make skillful, coordinated movements of the fingers of one or both hands and to grasp, place, or move small objects. This abillty involves the degree to which these finger movements can be carried out *quickly*.
28. *Wrist-Finger Speed* This is the ability to make *fast, simple,* repeated *movements* of the *fingers, hands, and wrists.* It involves little, if any, accuracy or eye-hand coordination.
29. *Speed of Limb Movement* This ability involves the *speed* with which a single movement of the arms or legs can be made. This ability does *not* include accuracy, careful control, or coordination of movement.
30. *Selective Attention* This is the ability to concentrate on a task and not be distracted. When distraction is present, it is not part of the task being done. This ability also involves concentrating while performing a boring task.
31. *Time Sharing* This is the ability to shift back and forth between two or more sources of information.
32. *Static Strength* This is the ability to use muscle force in order to lift, push, pull, or carry objects. It is the maximum force that one can exert for a brief period of time.
33. *Explosive Strength* This is the ability to use short bursts of muscle force to propel oneself or an object. It requires gathering energy for bursts of muscle effort over a very short time period.
34. *Dynamic Strength* This is the ability of the muscles to exert force repeatedly or continuously over a long time period. This is the ability to support, hold up, or move the body's own weight and/or objects repeatedly over time. It represents muscular endurance and emphasizes the resistance of the muscles to fatigue.
35. *Trunk Strength* This ability involves the degree to which one's stomach and lower back muscles can support part of the body repeatedly or continuously over time. The ability involves the degree to which these trunk muscles do not "give out," or fatigue, when they are put under such repeated or continuous strain.
36. *Extent Flexibility* This is the ability to bend, stretch, twist, or reach out with the body, arms, or legs.
37. *Dynamic Flexibility* This is the ability to bend, stretch, twist, or reach out with the body, arms, and/or legs, both quickly and repeatedly.
38. *Gross Body Coordination* This is the ability to coordinate the movement of the arms, legs, and torso together in activities where the whole body is in motion.
39. *Gross Body Equilibrium* This is the ability to keep or regain one's body balance, or to stay upright when in an unstable position. This ability includes being able to maintain one's balance when changing direction while moving or when standing motionless.
40. *Stamina* This is the ability of the lungs and circulatory (blood) systems of the body to perf rm efficiently over long time periods. This is the ability to exert oneself physically without getting out of br ath.
41. *Near Vision* This is the capacity to see close environmental surroundings.
42. *Far Vision* This is the capacity to see distant environmental surroundings.
43. *Visual Color Discrimination* This is the capacity to match or discriminate between color . This capacity also includes detecting differences in color purity (saturation) and brightness (brilliance).
44. *Night Vision* This is the ability to see under low light conditions.
45. *Peripheral Vision* This is the ability to perceive objects or movement towards the edge f the visual field.
46. *Depth Perception* This is the ability to distinguish which of several objects is more distan from or nearer to the observer or to judge the distance of an object from the observer.
47. *Glare Sensitivity* This is the ability to see objects in the presence of glare or bright ami nt lighting.
48. *General Hearing* This is the ability to detect and to discriminate among sounds that vary over broad ranges of pitch and/or loudness.
49. *Auditory Attention* This is the ability to focus on a single source of auditory information n the presence of other distracting and irrelevant auditory stimuli.
50. *Sound Localization* This is the ability to identify the direction from which an auditory s imulus originated relative to the observer.

Source: Reference 2.

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U.S. Department of Education - NCES
STUDY DESIGN WORKSHOP
on
Higher Order Thinking and Communication Skills of College Graduates
November 17-19, 1991

Position Paper
"Assessing College Education: What Can be Learned from Practices in Industry?"

Author
Peter Capelli

Reviewer
Elinor M. Greenberg

Overview

This paper is more descriptive than analytical and prescriptive. It demonstrates what a vide gap there is between what goes on in colleges and what is done in industry to assess knovledge, skills and abilities (KSA's): 1) college grading is general compared to the specificity of industrial measures; 2) college grades are not good predicators of job performance. So much for grade and transcript analysis as primary methods of national assessment. However, transcript analysis can be useful to shov patterns, disparities and consistencies over time (NLS '72).

The author draws two conclusions:

1) re-design colleges courses to focus on job relevant skills, such as: "group efforts, critical thinking in oral and written form, applications of math, and data analysis," and,
2) provide college transcripts to employers and also assemble and distribute additional and existing information about student performance "in a different way," i.e. across courses relative to skills, such as writing, applied math, etc., perhaps in portfolio form.

This reviever finds the Conclusions section of this paper weak. While acknovledging that many courses could be re-designed to be more directly related to employability skills, such activity alone does not help us, nov, to develop a national assessment process. Also, this reader does not think that transcripts, in their present form, are very useful to employers or to students. Portfolios are useful, but cumbersome. Grades given for generic skills across courses may be no more useful than current grades nov given by faculty for

courses. However, a new system of documentation could be developed that would be of more value to students, institutions and employers. (This reviewer developed competency-based transcripts in the 1970's that, although initially difficult to prepare and store, are extremely useful to thoughtful readers, i.e. State Departments of Education for Teacher Certification, potential employers and graduates themselves.) (see Comments by Reviewer)

Useful Measures

The most useful part of this paper is the information it provides to academics unfamiliar with industry's evaluation approaches. In itemizing various systems and procedures used by industry, it becomes clear that a wide variety of sub-skill definition systems and instruments are available and in use, now, and that these instruments have the confidence of various employers, consultants and sectors in the economy. The following summary may be of use in identifying particular processes that: 1) could be made known to and used in colleges, and, 2) could provide the basis for "assessment partnerships" between schools and employers.

Job Analysis - 7 major instruments identified

Emphasis is on application, integration, breadth, leadership, communication, interpersonal skills and behavioral skills. SCANS is especially promising.

Selection Tests - used at employment application and job entry points to predict job performance.

Ability Tests - subject-specific tests (except "pencil tapping," which appears to be "generic").

Bio Data - background information (especially "model airplane building" and other hobbies).

Work Samples - real work tasks and problems to be solved.

Comments by Reviewer

Within our discussion, the following ideas might be considered:

1. Collect instruments widely and effectively used by industry, compile a database and directory of such instruments, select a few model sub-skill schemes, and disseminate this information to colleges for

adoption and use in courses and in entry, mid-point and exit student assessment processes.

2. Use above in faculty development activities to orient faculty to industry's procedures and cultures and to encourage the use of sub-skills as course objectives and assessment criteria.

3. Develop a model "college transcript-as-career passport" to use as a tool for students, colleges and employers to document lifetime learning in schools, on-the-job and in other settings. This Career/Education Passport can be input into a computerized database and available in hard copy form. It should contain a wide variety of information on the learner: biodata, college course credits, grades; degrees; on-the-job training records; competency outcome statements; test scores, etc. The student/worker would "own" the Career/Education Passport. It would be transportable from school to school, job to job and career to career, throughout one's lifetime.

4. The Career/Education Passport could also be contained in a chip that is part of a "smart card," to be used as a transfer, registration, and tuition payment device to encourage and simplify recurrent lifelong learning and enrollment. Lifelong learning, thereby, translates into lifelong training and lifelong education through a commonly used, efficient, and well understood technological tool. This "smart card" would help to create an "American Lifelong Learning System" and would simplify the now complex and barrier-filled recurrent, lifelong entry and re-entry to formal learning. This kind of a tool could help create the kind of "seamless," integrated learning system now being widely discussed, but not yet a reality.

5. Career/Education Assessment Partnerships between schools and employers could be created, based on shared projects built around items 1-4 above. These "assessment partnerships" would provide a basis for collaborative and mutually supportive arrangements between the academic, business and labor sectors.

The technology to develop the above items is nov available, but not being widely used in the U.S. Issues of cost, attitude and feasibility should be investigated further.

Conclusions

The information in this paper does not permit this reviewer to choose specific instruments or sub-skill sets that might be used by a set of colleges or nationally. But, the paper does suggest that one strategy, among a number of strategies, could be to present to all U.S. colleges (3500+) and, perhaps, to public and private vocational schools (9000+) as well, an opportunity to choose a particular approach to assessment that would give us clusters of institutions, or states, along with like-minded businesses with which to partner.

In the aggregate, we could test the validity and practicality of a number of assessment approaches simultaneously. For the time being, I call this option the "Industry-Based Assessment Option." Some other options might be called the "Development-Based Assessment Option" (see Loaker paper), the "Institution-Based Assessment Option" (see Evell/Jones paper), and the "State-Based Assessment Option" (N.J., etc.).

In addition to these four options, which all U.S. institutions could choose among, thereby creating four approaches that could be compared as to effectiveness and efficiency, foundational data could also be collected nationally by coordinating efforts between the Department of Education and the Department of Labor. This kind of total effort could be called the "Coordinated Multi-Option National Assessment and Partnership System." If phased in and continued from 1992 to 2000, this eight year period would capture two traditional four-year baccalaureate cycles and bring us to "The Class of 2000" with a substantial national database, as well as with a de-centralized and diverse national assessment system. This pluralistic approach could satisfy the various constituencies and stakeholders which are nov and will continue to be major players in this process. It would also be "grass-roots," "team-based," "customer-driven" and focused on "continuous improvement," matching the Total Quality Management (TQM) approach, currently so credible with industry and government leaders who are working to improve America's productivity.

Review of Peter Capelli's "Assessing College Education: What Can Be Learned from Practices in Industry"

After effectively demonstrating that there is little or no correlation between performance in higher education and some of the simpler indicators of success in later work (e.g. getting a job or earning higher wages), except possibly for academic programs that are tightly tied to professions (e.g. business and education), Peter Capelli concludes that industry can teach higher education what qualities are needed in the work world. And indeed when he summarizes the various analyses of what workers need to know and be able to do, he finds that they have several requirements in common, including communications, critical-thinking, and problem-solving skills. That is, the national goals are consonant with the research done in the field.

That said, it seems that industry does not have much to teach higher education with respect to how those skills might be assessed. Selection tests used by industry are proprietary, often irrelevant to the college classroom (e.g., personality tests), and of questionable validity. As Dr. Capelli notes, "even the best of these procedures explain no more than a third or so of the variance in performance" -- not particularly promising, as he notes, "when one considers using the procedure as the basis for public policy -- billions of dollars and the efforts of tens of thousands of educators and millions of students." Ability tests have been found to be discriminatory and at best of "modest" validity. Their relationship to skills acquired in college is also problematic.

Dr. Capelli considers "bio-data" a better predictor of job performance than the tests, but it is hard to see how they can be used in higher-education assessment. It may be, for instance, that certain aspects of the college experience, such as participation in extracurricular activities, can be correlated with later job success. But how can this correlation be used to assess whether or not higher education is developing in students the skills the nation needs for the 21st century? And causation is a problem as well: does extracurricular activity cause later job success or do students who spontaneously pursue such activities have personality characteristics that will also serve them in good stead in the work world? And would that correlation break down if students not inclined to participate in extracurricular activity were dragged into it? A performance measure would still be needed to explore the causal relation.

Work samples are the "selection device closest to achievement tests," and Dr. Capelli maintains that one could make use of existing student work (like research papers, laboratory experiments, and the like) to assess college graduates' performance. This is, of course, the portfolio model of assessment. While this is an idea that may merit further investigation, some cautions are in order:

- Averaging the grades on written work, as Dr. Capelli suggests,

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takes us right back to the problem of the lack of correlation between grading and job performance. Portfolios need to be assessed according to a scoring guide that mirrors the skills, knowledge and abilities we want to measure. They are not themselves an assessment measure but merely the raw material to which the measure -- the scoring guide -- is applied. That implies the training of assessors.

o Portfolios, like work samples, capture only a small range of skills, though the range might be enough to include writing, critical thinking, and problem-solving. This is one reason why The College of William and Mary, which Dr. Capelli mentions as an example of an institution that has used this approach to the assessment of general education, has in fact abandoned it.

o I am not aware of tests of validity or reliability that have been done on portfolio assessment.

o Finally, they are a logistical nightmare to collect for large programs, even using sampling procedures, which is why they have turned out to be more useful for assessment in the major than assessment of general education. It would be very hard to collect comparable portfolios across higher education in the country, and the process would be expensive. And how do we factor into the overall report on student performance the lack of certain kinds of work in the students' portfolios? The College of William and Mary, for instance, found that they had trouble getting portfolios with enough written work in them to do anything even a crude assessment of writing skills.

Dr. Capelli makes a good, commonsensical argument for some practices in higher education that contribute to the skills he thinks are important for job performance, including the three in Goal 5. I think we would all agree that students should be required to write papers that are carefully corrected; to discuss material; to use verbal, mathematical and data analysis to analyze, think critically about, and solve problems that are linked to practice; and to work in teams. Students should not be given multiple choice tests and their learning should not be limited to memorization. In other words, classes should be small and instructors skillful and knowledgeable. But we do not need to spend "billions of dollars and the efforts of tens of thousands of educators and millions of students" to demonstrate what we already know. Funding those small classes will be expensive enough.

One final caveat: the national goals were developed in part because of a wide-spread perception that American workers are becoming increasingly less competitive in the world economy. So there is some reason to be skeptical that crude measures of job success in that American market correlate with the skills and abilities we should be striving to produce in the college educated.

Margaret A. Miller

Review of Assessing College Education: What Can be Learned from Practices in Industry? (Revision)

Mary L. Tenopyr
AT&T

This manuscript is vastly improved over the previous version; however I am still concerned about its main conclusions.

To suggest that traditional achievement tests and basic ability tests will predict little about future job success, I believe, is a misinterpretation of the literature. Much of what we know about predicting success of college graduates is based on studies of generalist managers. These testing studies do not focus on the increasingly large workforce of technical college graduates who are often not selected initially by test, but instead by quality of university attended, courses taken, grades, and professors under whom study was undertaken. On the other hand, generalist managers may be selected from persons with a variety of university majors. In the last two decades, test use has declined markedly, and the most plausible and defensible use of tests in selecting managers has been in large companies having an orientation toward generalist managers who are frequently rotated through different job assignments. Thus, any conclusions regarding the validity of tests for predicting job success of college graduates are, for the most part, based on particular samples in particular companies.

Even given the limitations of the sampling, the validation results for basic ability testing are in the range that will provide useful predictions. There is no indication that the so called "performance-based assessments" would be more valid. Industrial psychologists have long noted that there appears to be an impenetrable upper limit on the validity of predictors of degree of job success. The assessment center research shows that measures very similar to those performance measures proposed do not go above the barrier. Furthermore, there can be major problems regarding reliability, administration and validity integrity maintenance (VIM) over different administrators and over time.

What has been said should not negate the value of measurements in areas like oral communication in calling attention to the need for teaching these skills; however, it should be noted that overemphasis on certain skills may lead to neglect in teaching core subject matter.

Regarding the value of college grades as predictors of job success, it cannot be denied that they are not one of the better predictors of job success. Nevertheless, they are inexpensive predictors and may be extremely cost-effective, particularly when a company can afford to be highly selective and other conditions exist.

I feel that the coverage of job analysis needs more breadth; it is largely based on instruments from consulting firms and views of consultants. It should be noted that job analysis tools sold by consultants are designed to be generic and hence marketable; when psychologists in business do job analysis they often focus on job specific skills, which may be highly related to subject matter in curricula in college. What level of generality one uses in job analysis and whether one focuses on the worker or the job depends entirely on one's purpose in doing the job analysis. All purpose commercial job analysis instruments, must be generic and be suitable for use in a wide range of companies.

Also, it should be noted that selection is not necessarily the primary activity of industrial/organizational psychologists. Many work in training, organizational development, and other areas largely unrelated to selection.

Regarding selection tests, it should be noted that no respectable researcher would do a validation study in which the criterion was contaminated by those evaluating job performance having information about predictor scores.

I am still uncomfortable about the authors making a sharp distinction between aptitude and achievement. Also "innate" is an inappropriate modifier for ability. Furthermore, aptitude and intelligence are inseparable.

Again the Griggs case involved interpretation of a statute, not the U.S. Constitution.

Furthermore, the more recent literature on prediction clearly points out the limitations of the "percentage of the variance accounted for" interpretations of a coefficient of correlation.

It should be noted that biodata, although often useful in prediction, are not simple and straightforward. For example, not every life experience that would appear logically to be later predictive of job success in fact, is. Considerable research, involving large samples is required to establish the validity of life history items.

The matter is disparate impact of selection procedures on selected groups is a matter of grave concern and should not be discussed only within the context of biodata. In fact biodata items can be selected in such a way as to reduce adverse impact.

It can be expected that all objective predictors of job success will have a disparate impact on some group. Certainly, "performance-based assessment" could be expected to have no less adverse effect than the controversial aptitude tests.

There is no argument about the general validity of work samples; however, it should be pointed out that job knowledge tests have been criticized because of their high correlation with basic ability tests. The relationship of job knowledge tests to work samples is less clear.

Although I agree that employers' goals are relevant to determining national educational goals, I hope that all educators will continue to embrace broader concepts of the purposes of education. An informed citizenry is one of any country's greatest assets.